TACOM

Lethality, Survivability, Mobility and Sustainment for America's Army

Close Combat Armaments Center

High Recoil Munitions
Weapon Compatibility Issues & Shooter Effects

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Abstract

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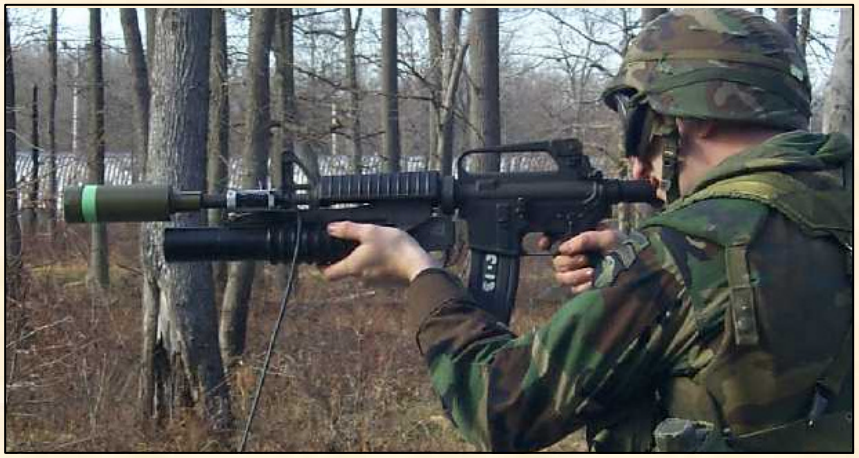
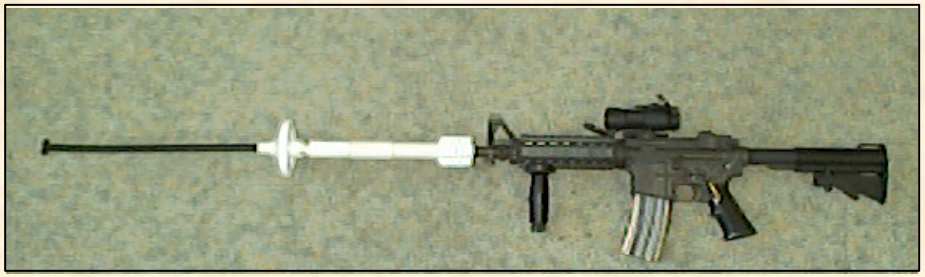
High Recoil Munitions
Weapon Compatibility Issues & Shooter Effects

Recent Military interest in Non Lethal and Specialty application ammunition

Proliferation of numerous new muzzle launched and other various systems which generate high recoil





Recoil - Basic Physics

Recoil Impulse (RI) – Momentum of the "system"

RI = Weapon Mass x Maximum Weapon Velocity
(As measured on a free recoil pendulum mount)

Recoil Energy (RE)

$$RE = \tfrac{1}{2} MV^2$$

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Generally, under similar conditions, Higher Mass projectiles result in higher recoil observed by shooter

Example: For similar 5.56mm cartridge propellant loads, the following is observed (as fired from an M16A2) :

Projectile	Projectile Weight	Velocity	Recoil Energy
M855	0.009 lb (62 grains)	3000 f/s	3 ft lb
XM95 balls	0.6 lb	277 f/s	58 ft lb

Difference in systems results in a recoil energy difference of 19X

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In addition to the newer Rifle Launched Systems, there are many other systems which possess high recoil characteristics.

- Past Development Programs (ARGM)
- Currently Fielded Systems
- Future Systems

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RECOIL MEASUREMENTS – ASSORTED SYSTEMS

Ammunition	Weapon	Firing Impulse (lb s)	Recoil Energy (ft lb)
5.56mm, M855	M16A2	1.38	3.3
7.62mm, M118	M24 SWS	2.85	9.2
12 GA 2.75”- 00	Winchester 1200	3.52	28.0
40mm, M433 HEDP	M203 on M16A2	2.93	11.7
XM95 Non Lethal	M4 Carbine	5.92	69.2
XM95 Non Lethal	M16A2	5.82	57.8
RLEM (1st design)	M16A2	7.45	101.6
RLEM (2nd design)	M16A2	5.68	58.94

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Issues related to high recoil in shoulder fired systems currently under development have seriously impacted the efforts to Type Classify these items.

- 5.56mm, XM95
- 5.56mm, RLEM

Shoulder fired systems under development in the recent past have also been impacted by recoil concerns

- ARGM

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Potential Recoil Issues in Weapon System Development

- Safety Limits / Restrictions (60 ft lb limit)
- Damage to Weapon / Ancillary Equipment
- Potential Long Term Shooter Aiming Effects

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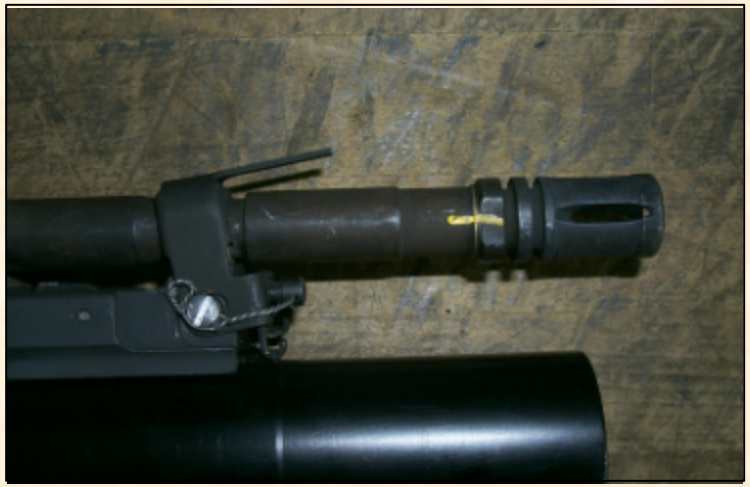
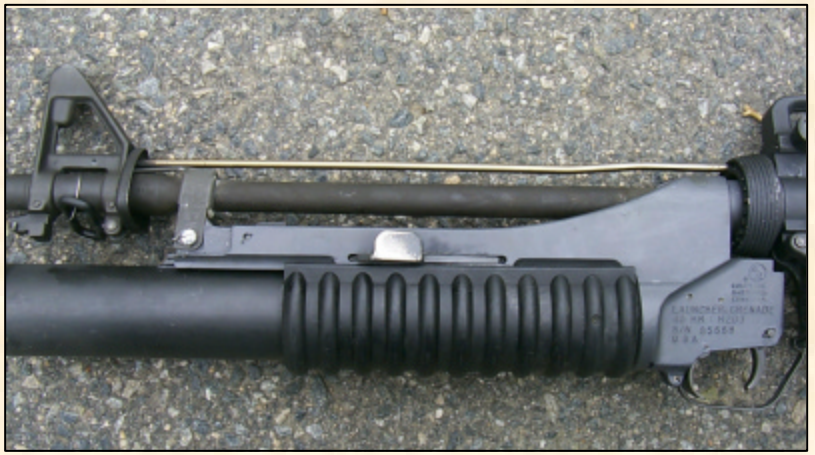
5.56mm, XM95 Rifle Launched Non Lethal Munition

High recoil had significant impact on termination of initial SEP program for failure to meet user requirements

- Firing of XM95 munition damaged M203 mounting bracket on M16A2 and M4





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XM95 Recoil Issues (cont.)

- When fired from M4, recoil exceeded the 60 ft lb limit
- When fired from the M16 or M16 with M203 or M4 equipped with the M203 the recoil is below, but near the recoil limit (shooter restricted to 25 rounds maximum per day)

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Impact of XM95 recoil on Soldier Performance was studied by the Army Research Laboratory (ARL), Human Research Engineering Directorate (HRED).

- Purpose of the study was to investigate the ability of soldiers to effectively hit targets after firing the high recoil XM95 system.

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1. Large male soldier - M16

2. Small female soldier - M16

XM95 Firings

3. Large male soldier - M4

4. Small female soldier - M4

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5.56mm, Rifle Launched Entry Munition (RLEM)

High recoil of this system required significant re-design of system and slippage of milestones

- System recoil exceed 60 ft lb recoil limit
- Modifications have reduced recoil to acceptable levels

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- For all current / future shoulder fired muzzle launched items, recoil will likely continue to be an issue.

- Recoil issues need to be addressed early on in the developmental cycle to avert costly program delays due to:

  System modifications
  Potential failures in meeting program requirements.

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With all of the recent issues regarding high recoil in small arms weapon systems, established recoil limits have become a “hot” topic in the small arms community.

The current established limits are as follows:

- 60 ft lb - Maximum Recoil Limit - (DTC TOP 3-2-504)
- 45-60 ft lb - Soldier restricted to firing 25 rounds / day (TECP 700-700)

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- September 2000 – Edgewood Arsenal, MD
  Small Arms community held Meeting to discuss recoil situation with regard to small arms weapon systems

- Where/Why did recoil limits originate ?
- Are they valid limits ?
- Were they based on actual physiological effects on humans ?
- Should we be basing our program decisions on these values ?
- Extensive Literature search conducted – nothing discovered

- Conclusion – All parties involved agreed that a scientific study is required to better define recoil limits

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Ongoing / Future Actions Regarding Small Arms Recoil

- All involved parties agree on need to better define recoil parameters
- Project Officer has been assigned at Medical Research Materiel Command (MRMC) to investigate recoil "problem" – no official program has been initiated
- Veterans Administration (VA) Hospital, East Orange, NJ is capable of and has shown interest in conducting the required studies
- Need to identify funding source to conduct necessary studies. No single program can afford to fund this effort.

CONCLUSION

- Resolution of high recoil issues not likely to be resolved soon